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Ce-, Tb-, and Sm-Doped Luminescent Glasses for White Light Emitting Diodes

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In recent years, phosphor-converted white light emitting diodes (W-LEDs) have attracted much attention because they are considered as an advanced lighting technology compared to conventional incandescent and fluorescent lamps for future general lighting. Luminescent glasses could be an alternative to phosphors for W-LEDs. In fact, compared with powder phosphors, luminescent glasses possess some advantages, such as homogeneous light emission, low fabrication cost, simple manufacturing procedure, excellent thermal resistance, and epoxy resin-free in assembly process.

In this presentation we report our recent findings about the Ce-, Tb-, and Sm-doped silicate glasses that can be used for W-LEDs. These glasses were prepared via the melt-quenching method, and studied in terms of absorption spectra, photoluminescence excitation and emission spectra, decay curves, Commission Internationale de L'Eclairage (CIE) color coordinates, and correlated color temperatures (CCTs). We study the effect of addition of minor components such as B_2O_3, Al_2O_3, ZnO, CaO, Na_2O and CaF_2 on the luminescent properties of the glasses. The results show that the emission spectra, color coordinates, and CCTs of the glasses can be tuned by varying the glass compositions and the excitation wavelengths. This gives the possibility to obtain smart lighting under the excitation of commercial wavelength-tunable UV-LEDs. In addition, energy transfer from Ce^{3+} to Tb^{3+} and Sm^{3+} ions occurs in Ce/Tb/Sm co-doped glasses, which was analyzed using fluorescence spectra, decay lifetimes, and energy level diagrams. Furthermore, Ce/Tb/Sm co-doped silicate glasses exhibit white light emission under ultraviolet light excitation due to the combination of violet-blue, green and orange-red light from Ce^{3+}, Tb^{3+} and Sm^{3+} ions, respectively. The results demonstrate that the as-prepared Ce/Tb/Sm doped silicate glasses can serve as a promising candidate for developing W-LEDs.